Computational Modeling of Nondestructive Evaluation, Defect Detection, and Defect Identification for CFRP Composites

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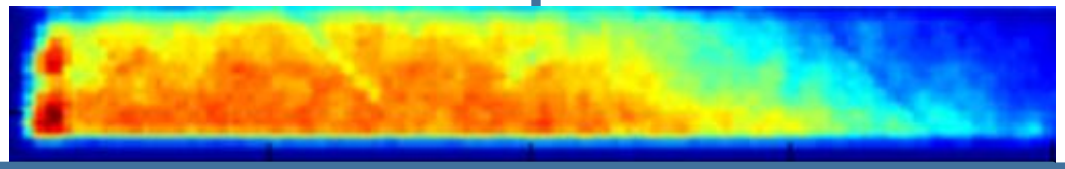
Research Objectives

- Implement computational NDE measurement simulation for large CFRP composite structures
  - Ultrasound
  - Thermography
- Advance SOA in defect classification and characterization through model-based data inversion using *a priori* defect class characteristics
- Minimal previous progress on model-based data inversion warrants TRL1.5
- Proposed work will advance technology to TRL 2.5 through laboratory proof-of-concept



Ultrasound map of distributed CFRP matrix micro-cracking

Approach

- Implement computational simulation of NDE
  - Ultrasound
    - Boundary and volume integral equation methods
    - Analytical approximation methods
  - Thermography
    - Finite element methods
- Implement model-based defect characterization
  - Constrain ill-posed inversion using measures of *a-priori* specified defect properties
- Utilize fusion of thermography and ultrasound data in defect classification and characterization
- Verify and validate through comparison to experimental data from composite test samples

Impact

- Computational NDE simulation enables inspection optimization for large CFRP composite structures
- Defect classification and characterization in large CFRP composite structures:
  - Provides critical material state information for component certification and lifecycle management
  - Enables lifing decisions utilizing model-based damage tolerance and residual strength analysis
- Will benefit all manufacturing industries, beyond the aerospace composite community.